

Claims

1. An etching solution having an etch rate of 2 Å/minute or greater for a film having a relative dielectric constant of 8 or higher (a High-k film), and whose ratio of the etch rate for a thermal oxide (THOX) film to the etch rate for a High-k film ( $[\text{THOX etch rate}]/[\text{High-k film etch rate}]$ ) is 50 or less.

2. An etching solution according to Claim 1, wherein the High-k film has a relative dielectric constant of 15 or greater.

3. An etching solution according to Claim 1, wherein the High-k film is a hafnium oxide film, a zirconium oxide film, or a lanthanum oxide film.

4. An etching solution according to Claim 1, wherein the High-k film comprises at least one member selected from the group consisting of hafnium silicate ( $\text{HfSiO}_x$ ), hafnium aluminate ( $\text{HfAlO}$ ),  $\text{HfSiON}$ ,  $\text{HfAlON}$ ,  $\text{ZrSiO}$ ,  $\text{ZrAlO}$ ,  $\text{ZrSiON}$ ,  $\text{ZrAlON}$ , alumina ( $\text{Al}_2\text{O}_3$ ),  $\text{HfON}$ ,  $\text{ZrON}$  and  $\text{Pr}_2\text{O}_3$ .

5. An etching solution according to Claim 1, wherein the etch rate for the thermal oxide (THOX) film is 100 Å/minute or less.

6. An etching solution according to Claim 1, which contains hydrogen fluoride (HF).

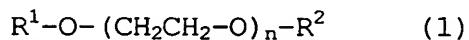
7. An etching solution according to Claim 1, wherein the hydrogen fluoride concentration is 3 mass% or greater.

8. An etching solution according to Claim 1, which contains hydrogen fluoride and an organic solvent comprising a heteroatom.

9. An etching solution according to Claim 8, wherein the organic solvent comprising a heteroatom is an ether compound, a ketone compound, or a sulfur-containing heterocyclic compound.

10. An etching solution according to Claim 9, wherein the organic solvent comprising a heteroatom is an ether compound.

11. An etching solution according to Claim 10, wherein the ether compound is at least one member selected from the group consisting of compounds represented by General Formula (1)



wherein n is 1, 2, 3 or 4,  $R^1$  and  $R^2$  may be the same or different and each represents a hydrogen atom, a lower alkyl group or a lower alkyl carbonyl group, with the proviso that  $R^1$  and  $R^2$  are not both hydrogen atoms.

12. An etching solution according to Claim 10, wherein the ether compound has a relative dielectric constant of 30 or less.

13. An etching solution according to Claim 8, wherein the organic solvent comprising a heteroatom contains at least one carbonyl group in its molecular.

14. An etching solution according to Claim 8, wherein the organic solvent comprising a heteroatom has at least one hydroxy group in its molecular.

15. An etching solution according to Claim 10, wherein the ether compound is at least one member selected from the group consisting of tetrahydrofuran, tetrahydropyran, furan, furfural,  $\gamma$ -butyrolactone, monoglyme, diglyme, and dioxane.

16. An etching solution according to Claim 10, wherein the ether compound is at least one member selected from the group consisting of ethylene glycol methyl ethyl ether, ethylene glycol diethyl ether, diethylene glycol methyl ethyl ether, diethylene glycol diethyl ether, triethylene glycol dimethyl ether, triethylene glycol diethyl ether, triethylene glycol ethylmethyl ether, tetraethylene glycol dimethyl ether, tetraethylene glycol diethyl ether, and polyethylene glycol dimethyl ether.

17. An etching solution according to Claim 10, wherein the ether compound is at least one member selected from the group consisting of ethylene glycol monomethyl ether acetate, ethylene glycol monoethyl ether acetate, ethylene glycol monobutyl ether acetate, diethylene glycol monomethyl ether acetate, diethylene glycol monoethyl ether acetate, diethylene glycol monobutyl ether acetate, triethylene glycol monomethyl ether acetate and triethylene glycol monoethyl ether acetate.

18. An etching solution according to Claim 10, wherein the ether compound is at least one member selected from the group consisting of an ethylene glycol monomethyl ether, ethylene glycol monoethyl ether, ethylene glycol monopropyl ether, polyethylene glycol monomethyl ether, ethylene glycol monoisopropyl ether, ethylene glycol monobutyl ether, propylene glycol monomethyl ether, propylene glycol monopropyl ether and propylene glycol monobutyl ether.

19. An etching solution according to Claim 9, wherein the sulfur-containing heterocyclic compound is at least one member selected from the group consisting of sulfolane and propane sultone.

20. An etching solution according to Claim 1, which contains hydrogen fluoride (HF) and an organic solvent comprising

a heteroatom, wherein the ratio of HF : heteroatom-comprising organic solvent : water = 3 mass% or greater : 50 to 97 mass% : 10 mass% or less.

21. A method for producing an etched article using the etching solution of Claim 1, the method comprising a step of etching an object to be etched having a silicon oxide film and a film having a relative dielectric constant of 8 or greater, and a gate electrode that is formed on the film having a relative dielectric constant of 8 or greater.

22. An etched article obtained by the method of Claim 21.